

## ***Protospirura okinavensis* sp. n. (Nematoda: Spiruridae) from *Mus caroli* on Okinawa Island, Japan**

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**ABSTRACT:** *Protospirura okinavensis* sp. n. is described from *Mus caroli* on Okinawa Island, Japan. *Protospirura okinavensis* is readily distinguished from other members of the genus by the number and arrangement of caudal papillae, the size and length ratio of the spicules, and the egg dimensions.

**KEY WORDS:** *Protospirura okinavensis* sp. n., Nematoda, Spiruridae, taxonomy, mouse, *Mus caroli*, Rodentia, Muridae, Okinawa Island, Japan.

During a survey of the helminth fauna of the Ryukyu Archipelago, Japan, *Protospirura* sp. was recorded from the Ryukyu mouse, *Mus caroli*, on Okinawa Island (Hasegawa et al., 1986). Close examination revealed that this nematode is new to science and is described herein.

### **Materials and Methods**

Rodents were captured with live traps in the sugar cane fields. They were killed with ether, and their viscera were examined under a dissecting microscope. Nematodes were fixed with 70% ethanol at 70°C, cleared in glycerin-alcohol solution, and mounted in 50% glycerin on slides. Figures were made with the aid of a drawing tube. Measurements given are for the holotype male and the allotype female, followed in parentheses by the ranges of paratype males and females. All measurements are in millimeters unless otherwise stated.

### **Description**

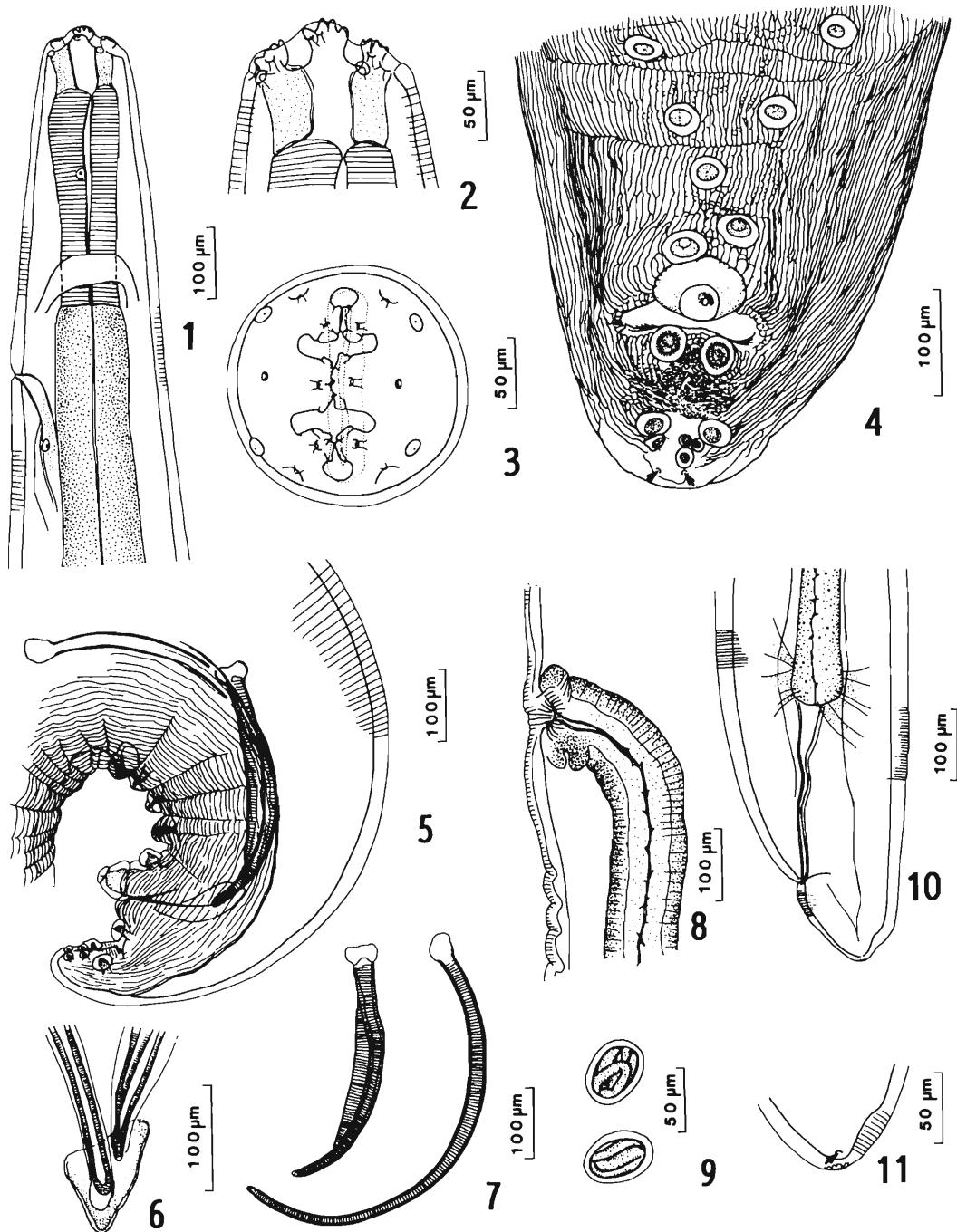
#### ***Protospirura okinavensis* sp. n. (Figs. 1-11)**

**GENERAL:** Nematoda, Spiruroidea, Spiruridae, Spirurinae, *Protospirura*. Medium-sized stout worm. Slightly reddish in color. Cuticle thick with transverse striations. Anterior extremity with highly developed pseudolabia raised above oral opening (Figs. 1, 2). Oral opening dorsoventrally elongated, constricted by 2 lateral elevations and 4 small submedian formations, lateral and submedian formations each with 4 teeth (Figs. 2, 3). Buccal cavity without tooth (Figs. 2, 3). Four large submedian cephalic papillae and 2 subdorsal and 2 subventral papillae in cuticular depressions, forming outer circle. Six small labial papillae present on lateral elevations and submedian formations, forming inner circle. Amphidial pores slightly inside of outer circle of cephalic papillae (Fig. 3). Pharynx thick walled, laterally compressed (Figs. 2, 3). Esophagus divided into anterior muscular and posterior glan-

dular portions (Fig. 1). Nerve ring in posterior  $\frac{1}{3}$  of muscular esophagus (Fig. 1). Excretory pore near junction of muscular and glandular portions of esophagus (Fig. 1). Deirids small, near anterior part of muscular esophagus (Fig. 1). Phasmidial pores subterminal (Figs. 4, 11).

**MALE** (holotype and 3 paratypes): Posterior extremity coiled (Fig. 5). Length 17.7 (16.3-24.6), maximum width in region of posterior body 0.53 (0.43-0.60). Head diameter 0.12 (0.11-0.12). Pharynx 0.07 (0.06-0.07) long. Muscular portion of esophagus 0.29 (0.28-0.33) long and 0.09 (0.09-0.10) wide; glandular portion of esophagus 3.75 (3.73-4.35) long and 0.15 (0.14-0.16) wide. Nerve ring 0.31 (0.30-0.40) and excretory pore 0.48 (0.41-0.51) from anterior extremity. Caudal alae thick. Ventral surface of posterior part ornamented with numerous striae arranged longitudinally but also irregularly or transversely in postanal portion (Figs. 4, 5). Spicules markedly dissimilar: right spicule slender, 0.62 (0.60-0.65) long; left spicule stout, alate, 0.32 (0.32-0.35) long (Fig. 7). Gubernaculum poorly chitinized, triangular in ventral view, 0.12 (0.11-0.16) long (Fig. 6). Preanal caudal papillae 5 or 6 pairs, large, and arranged asymmetrically. One large unpaired median papilla on anterior anal lip. Postanal papillae in 4 pairs: 2 pairs large, on posterior anal lip and at posterior  $\frac{1}{3}$  of tail; 2 pairs small, posterior to large pair (Figs. 4, 5). Tail conical, 0.18 (0.16-0.22) long, with round tip (Figs. 4, 5).

**FEMALE** (allotype and 8 paratypes): Length 40.1 (27.8-44.4), width at midbody 0.84 (0.51-1.15). Head diameter 0.17 (0.16-0.19). Pharynx 0.08 (0.08-0.11) long. Muscular portion of esophagus 0.32 (0.27-0.36) long and 0.14 (0.10-0.16) wide; glandular portion of esophagus 4.57 (3.97-5.30) long and 0.23 (0.16-0.27) wide. Nerve



**Figures 1–11.** *Protospirura okinavensis* sp. n. from *Mus caroli* on Okinawa Island, Japan. 1. Anterior part of holotype male, lateral view. 2. Cephalic extremity of holotype male, lateral view. 3. Cephalic extremity of paratype female, apical view. 4. Posterior part of paratype male, ventral view. 5. Posterior part of holotype male, lateral view. 6. Gubernaculum and distal tips of spicules of paratype, ventral view. 7. Spicules of holotype, lateral view. 8. Vulva of paratype, lateral view. 9. Uterine eggs. 10. Posterior part of allotype female, lateral view. 11. Posterior extremity of allotype female, lateral view. Arrows indicate phasmidial pores.

ring 0.38 (0.33–0.42) and excretory pore 0.53 (0.44–0.54) from anterior extremity. Vulva without ornamentation, at middle of body, 19.4 (13.6–22.4) from anterior extremity (Fig. 8). Vagina directed posteriorly (Fig. 8). Tail conical, with small tuberclose area at tip, 0.29 (0.22–0.31) long (Figs. 10, 11). Eggs elliptical, thick shelled, containing developed larvae at deposition, 45–50 × 30–33  $\mu\text{m}$  (Fig. 9).

HOST: *Mus caroli*.

SITE IN HOST: Stomach.

LOCALITY: Isagawa, Nago-shi, and Okuma, Kunigami-son, Okinawa Island, Japan.

DATE OF COLLECTION: 12 December 1984 (at Isagawa) and 14 August 1985 (at Okuma).

SPECIMENS DEPOSITED: Holotype and allotype in USNM Helm. Coll. No. 80944; paratypes in National Science Museum, Tokyo, NSMT As-1955.

### Discussion

The genus *Protospirura* Seurat, 1914 is composed of a relatively small number of species in spite of its worldwide distribution. Quentin (1969) listed 8 species and subspecies in the genus: *P. numidica numidica* Seurat, 1914; *P. numidica criceticola* Quentin et al., 1968; *P. anopla* Kreis, 1938; *P. armeniana* Alojan, 1951; *P. chabaudi* Vuylsteke, 1964; *P. muricola* Gedoelst, 1916; *P. peromysci* Babero and Matthias, 1967; and *P. suslica* Schulz, 1916. Four species have been proposed as *Protospirura* subsequently: *P. chanchensis* Ibáñez, 1966; *P. paucidentata* Wang et al., 1978; *P. srivastavai* Gupta and Trivedi, 1987; and *P. pseudomuris* Yokohata and Abe, 1989. However, the former 3 species are considered to belong to a different subfamily, Spirocercinae, because the pharynx is not compressed laterally (cf. Ibáñez, 1966; Chabaud, 1975; Wang et al., 1978; Gupta and Trivedi, 1987). *Protospirura pseudomuris* is a typical member of *Protospirura*. Yokohata and Abe (1989) stated that in *P. pseudomuris* the lateral elevations of the oral opening lack denticles and each of the submedian formations has only 1 denticle. However, in the cephalic ends figured by them (Figs. 9, 10) the lateral formation and the submedian formations each have at least 2 denticles.

*Protospirura okinavensis* is readily distinguished from other members in that all of them have more than 5 pairs of postanal papillae. Other distinguishing characteristics are as follows. *P. numidica numidica* and *P. numidica criceticola* have longer spicules (right 0.83 mm and left 0.42

mm in a male 22 mm long in *P. n. numidica*; right 1.15–1.42 mm and left 0.40–0.64 mm in males 13–22 mm long in *P. n. criceticola*) (Chitwood, 1938; Quentin et al., 1968). *Protospirura muricola* has spicules of nearly equal length (Chitwood, 1938; Quentin, 1969). *Protospirura anopla* lacks an unpaired papilla on the anterior anal lip and has 2 pairs of large papillae forming the anterior group of postanal papillae and larger eggs (39.2–61.0 × 30.4–34.8  $\mu\text{m}$ ;  $\bar{x} = 52.4 \times 34.8 \mu\text{m}$ ) (Kreis, 1938). *Protospirura armeniana* has 3 pairs of large postanal papillae (Skrjabin and Sobolev, 1963). *Protospirura chabaudi* Vuylsteke, 1964 lacks a denticle on the lateral elevations around the oral opening and unpaired preanal papillae and has a postequatorial vulva (Vuylsteke, 1964). *Protospirura peromysci* has a longer right spicule (0.82–1.20 mm in males 11.6–18 mm long) than that of *P. okinavensis*, although the left spicule is almost the same in length (0.33–0.38 mm) (Babero and Matthias, 1967). *Protospirura suslica* has 2 pairs of large papillae arranged in a line just posterior to the anus (Skrjabin and Sobolev, 1963). *Protospirura pseudomuris* has a longer esophagus and long conical tail in both sexes; caudal alae are wider in the male, and the vulva of the female is situated in the anterior  $\frac{1}{3}$  of the body (Yokohata and Abe, 1989).

Besides *P. okinavensis*, some nematode species of the superfamily Spiruroidea have been known from mammals of the Ryukyu Archipelago: *Gongylonema neoplasticum* (Fibiger and Ditlevsen, 1914) from *Rattus norvegicus*, *R. rattus*, and *Apodemus speciosus* (cf. Kawashima et al., 1965; Kamiya et al., 1968; Yagi et al., 1983; Hasegawa et al., 1986); *Gongylonema* sp. and *Cylcospirura (Gastronodus) strasseni* (Singh, 1934) from *Suncus murinus* (Uchikawa et al., 1981; Hasegawa et al., 1986); *Mastophorus muris* (Gmelin, 1790) from *Apodemus speciosus* (Yagi et al., 1983); *Ascarops strongylina* (Rudolphi, 1819) and *A. dentata* (Linstow, 1904) from *Sus scrofa riukiuanus* (Shoho and Machida, 1979; Uchida et al., 1984; Hasegawa et al., 1985). *Phyocephalus sexalatus* (Molin, 1860) was also found among the nematode specimens collected from *S. s. riukiuanus* on Amami-oshima Island (cf. Uchida et al., 1984, Fig. 1).

Many of the wild mammals of the Ryukyu Archipelago are considered to have come from the adjacent areas through land connections in the Pleistocene, although some were introduced rather recently. The nematodes might also have

been brought into this area by their hosts. Although many of the spiruroids listed above are cosmopolitan parasites, *C. (G.) strasseni* and *A. dentata* are known only from relatively limited areas south to the Ryukyu Archipelago (cf. Yamaguti, 1961), suggesting that their hosts had come from continental China through Taiwan. *Mus caroli*, which inhabits cultivated fields and is distributed in Southeast Asia and Taiwan as well as the Ryukyu Archipelago (Corbet and Hill, 1986), probably had its origin in Southeast Asia. *Protospirura okinavensis* or other closely related species probably parasitize *Mus caroli* in Southeast Asia and/or Taiwan.

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